Santee Cooper

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VIA E-MAIL

October 17, 2008

Joe Eller
BAQ Permitting
Department of Health and Environmental Control
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RE: *Santee Cooper Pee Dee Case-by-Case MACT*
Follow Up to DHEC Request for Supplemental Information

Dear Mr. Eller:

This letter provides additional information that has been requested regarding the Case-by-Case MACT Permit Application submitted by Santee Cooper for the Pee Dee facility, and as a follow up to the remaining issues from the Department. Summaries of the topics addressed are provided in the following list with details on each later in this letter.

1. Would a carbon burnout system reduce fly ash mercury levels (when using activated carbon injection [ACI]) adequately to allow traditional fly ash end uses?
2. Would coal cleaning result in reduced coal mercury levels and subsequent reduced mercury emissions?
3. Could an ACI/fly ash mixture be saleable to other end uses, such as concrete block manufacturing or supplemental road aggregate?
4. If other proposed coal units included ACI injection, what differentiates them such that the costs of ACI injection were deemed reasonable?
5. If variability calculations were conducted on a lb/TW-hr basis (power output) rather than a lb/TBtu-basis (heat input) and the Pee Dee-specific heat rate were used, what would the resulting MACT floor be for Pee Dee?
6. Other facilities have expressed mercury control costs on a kW-hr basis rather than a cost-effectiveness value. What result would this have for Pee Dee?
7. Calculate post control PM, CO, and SO_2 emissions using the predicted maximum control efficiency of the control devices.

1. Carbon Burnout Impact on Fly Ash End Uses

Fly ash has two end uses, as discussed in the submitted permit application.

- ▲ Fly ash can be fed to a cement kiln as a raw material replacement, primarily for alumina but also partly for silica, iron and calcium. In this case, the fly ash becomes part of the clinker that is then ground to become cement.

- Fly ash is a pozzolan, in that it fills the gaps between cement particles and creates stronger concrete than cement alone. When used in this manner, fly ash is blended with finished cement and serves as a cement replacement.

Fly ash that is treated through the carbon burnout (CBO) system is only sold to Redi-Mix type concrete batch plants. Cement manufacturers do not accept fly ash that has been treated with the carbon burnout system. Regardless of the impact of the carbon burnout system on mercury levels in the ash, when used as a raw material replacement for cement kiln feed, any mercury sorbent can prevent the usage of fly ash. The Cement MACT prohibits the usage of fly ash with any mercury sorbent from being used as a raw material replacement in any cement kiln.[1]

Usage of fly ash as a cement replacement is possible presuming the CBO adequately reduces the carbon concentration to non-ACI levels. Usage of a CBO in this manner raises the additional question of how the released mercury would then be captured and treated. However, this question is moot, since even when a very large portion of the fly ash could still be sold, the cost of ACI injection alone (not inclusive of the capital and operating cost of a CBO unit) is still far above any value deemed cost effective for mercury control.[2]

2. Coal Cleaning and Impact on Mercury Emissions

Coal washing has the potential for removing mercury prior to coal combustion. In EPA's 1997 Report to Congress on mercury, EPA noted that 77% of Eastern and Midwestern bituminous coal is washed to meet customer-defined specifications. The report cited a mercury reduction ranging from 0-64%, and that, on average, a 21% reduction in mercury concentration was achieved.[3] In a subsequent report, EPA stated that coal cleaning has the potential to reduce the mercury associated with incombustible mineral materials (rock) associated with coal, but not mercury associated with the organic carbon structure of coal. This report cited an additional study for which the average mercury reduction was 37%, for 24 samples of cleaned coal, and the range was 12-78%.[4] Given the variability of results, the report concluded that, "there are no easily identifiable coal deposits or coal types that will reliably benefit from cleaning, with respect to reducing Hg content."

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[1] See generally 71 FR 76518, December 20, 2006. See also 40 CFR 63.1344(g).

[2] See Item No. 4 on Page 3 of the letter dated September 15, 2008, from Mr. Jay Hudson (Santee Cooper) to Mr. Joe Eller (DHEC). As documented in that letter, assuming 95% of the fly ash could be sold, the cost of ACI injection would still be at least $143,207/lb.

[3] Mercury Study Report to Congress, EPA-452/R-97-004, USEPA, December 1997.

[4] Control of Mercury Emissions from Coal-Fired Electric Utility Boilers: Interim Report, EPA-600/R-01-109, USEPA, April 2002.

A study by the Indiana Geological Survey found that, for the Indiana coal beds studied, "the average reduction in mercury concentration is 39 percent."[5] The range of reduction varied widely for Indiana coals evaluated, from 9% to 92%. The study found that, in general, "coals rich in pyrite experience greater mercury reduction…." The state of Pennsylvania evaluated coal washing data from the Homer City power plant, and found that the mercury reduction ranged (for that single power plant) from 24% to 70%.[6]

There are several relevant issues relating to use of coal washing for mercury control, including:

- Most eastern coals are already washed, so the emission rates for the best controlled units, as well as Santee Cooper's estimates for future coal deliveries to the Pee Dee facility, already incorporate the contribution of some level of mercury reduction via washing.
- Coal washing is not a single performance-level technology. In general, there are no data relating the degree of coal washing to the level of mercury reduction.
- It is not clear if coal washing preferentially reduces specific species of mercury, or otherwise changes the coal chemistry in a way that impacts mercury emissions beyond reducing the mercury input to the boiler. For example, if coal washing reduced coal chlorine levels (along with mercury levels), the net effect of washing could be an increase in emissions after the application of traditional air pollution controls. Likewise, if the mercury eliminated were predisposed to evolve into particulate mercury in the flue gas (which is almost entirely eliminated by a fabric filter), then the contribution of a large reduction in coal mercury via washing might not impact overall emissions at all. Finally, if the coal washing process resulted in a higher quality of coal, leading to less unburned carbon in the flyash, then the sorption of mercury exiting the boiler by the ash would likely decrease and emissions of mercury could increase. These are speculative considerations, but considerations for which we could find no publicly available data suggesting that they are not relevant to emissions.
- A response by the Virginia City Hybrid Energy Center to a data request by the Virginia Air Pollution Control Board stated that, "washing also reduces chlorine content which acts to reduce mercury emissions by oxidizing the mercury."[7] In other words, when you wash out the chlorine, you decrease the conversion of difficult-to-remove elemental

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[5] Mercury Content of Indiana Coals, Mastalerz, et. al., Indiana Geological Survey, Indiana University. http://igs.indiana.edu/Geology/coalOilGas/mercuryInCoal/index.cfm

[6] Final Decision Document for Reducing Mercury Emissions From Coal-fired Electric Generating Units, Commonwealth of Pennsylvania Department of Environmental Protection, Bureau of Air Quality, September 2006 (Table 3).

[7] Virginia City Hybrid Energy Center Response to Data Request (by) Bruce Buckheit, Member, Virginia Air Pollution Control Board, [Question from page 12 of request].

mercury to easily-removed oxidized mercury in the flue gas, and tend to increase mercury emissions.

For a power plant that purchases coal from multiple sources, as all current Santee Cooper coal-fired power plants do, and as the Pee Dee facility will, it is virtually impossible to predict the degree to which coal washing will already be taking place on coals provided, or the effectiveness of that coal washing on mercury content of the coal, much less the impact on mercury emissions.

3. Other Saleable Uses for ACI/Fly Ash Mixture

Fly ash has only two saleable end uses, which are discussed in the response No. 1. Neither concrete block manufacturing nor supplemental road aggregate are possible uses for fly ash, though bottom ash is saleable for these two uses.

Bottom ash is fundamentally different in structure than fly ash. While fly ash is typically a fine, powdery material, bottom ash is comprised of much larger material, somewhat like very coarse, glass-like sand with fine gravel mixed in.

4. Differences in Pee Dee and Other Proposed Projects using ACI

In short, the key differentiation in the cost effectiveness of ACI for other projects turns on two factors. First, most of those projects have far higher uncontrolled elemental mercury levels due to low chlorine in the coal (sub-bituminous and lignite units). Second, these projects also have far lower SO_2 and H_2SO_4 levels in the exhaust gas (sub-bituminous and lignite pulverized coal units, all circulating fluidized bed units) and thus require lower rates of ACI injection.

Note that there are no recently permitted or proposed projects that are a similar source to Pee Dee that include ACI injection.

The following pulverized coal units combusting lignite or sub-bituminous coals have ACI injection. (Note that most of these have not been built or operated because the permitting process is still pending or just recently completed.)[8]

1. GA – LS Power Longleaf
2. IA – Mid-American Council Bluffs
3. MI – Consumers Energy (based on 112g Application)

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[8] Based on previous communication with DHEC, Santee Cooper has also reviewed and included in this list submitted applications for coal-fired utilities in Michigan and Texas that have not yet received a final permit.

4. MI – Mid-Michigan Energy, LLC (based on 112g Application)
5. MO – City Utilities Springfield (112g minor – ACI optional)
6. NE – Omaha Public Power – Nebraska City
7. TX – NRG Texas Power Limestone Unit 3 (based on 112g Application)
8. TX – LS Power Sandy Creek
9. WI – WPSC Weston
10. WY – Basin Electric Dry Fork

The following circulating fluidized bed units include ACI injection. (Note that many of these have not been built or operated). [9]

1. IL – Enviropower (ACI optional)
2. IL – Indeck Elwood (ACI optional)
3. MI – Holland Board of Public Works (based on 112g Application)
4. MI – Wolverine Power Supply Cooperative (Draft Permit to Install)
5. ND – Great River Spiritwood
6. VA – Dominion Wise

Note that there are no recently permitted or proposed projects for a similar source where a BACT determination or a case-by-case MACT determination resulted in the requirement to use ACI. Santee Cooper believes that the reason for this absence is obvious – the low inherent mercury emission rates from the Pee Dee project (and similar projects) and the high ACI injection rates required result in costs that are far beyond any accepted cost-effectiveness level. The Michigan Department of Environmental Quality supports this belief with the following quote from the Wolverine Power Supply Cooperative Draft Permit to Install Fact Sheet:[10]

"Also, with bituminous coals, certain combinations of air pollution control devices designed to control other criteria pollutants have been shown to provide a co-benefit reduction in mercury emissions that are as great if not greater than carbon injection."

While this statement was made in regards to bituminous coal as a secondary fuel for a circulating fluidized bed unit, it demonstrates MDEQ's understanding that ACI is not additionally effective for bituminous coal firing.

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[9] Based on previous communication with DHEC, Santee Cooper has also reviewed and included in this list submitted applications for coal-fired utilities in Michigan that have not yet received a final permit.

[10] Michigan Department of Environmental Quality – Air Quality Division; *Public Participation Documents for Wolverine Power Supply Cooperative, Inc. – Rogers City, Michigan.* Permit Application Number 317-07, September 23, 2008 and revised on September 24, 2008 - Page 44.

5. Emission Limits on a Power Output Basis

In the Case-by-Case MACT application, Santee Cooper proposed that DHEC select an output-based performance standard expressed in terms of lb/MWh gross, based on a 12-month average, in accordance with the form of the MACT standard adopted by EPA in the 2004 Utility MACT proposal. Considering an output-based performance standard in this Case-by-Case MACT application promotes consistency with EPA's outline, as well as it promotes improved energy efficiency.

EPA expressed a clear intent to prevent pollution by promoting improved efficiency in the following quote from the preamble to the 2004 Utility MACT proposal.

> *"... in an effort to promote energy efficiency in utility steam generating facilities, the Administrator is proposing output-based standards for new sources for emissions of Hg and Ni under this rule."*[11]

Beyond simply promoting energy efficiency, EPA goes on to acknowledge that

> *"... input-based limitations allow units with low operating efficiency to emit more per megawatt (MWe) of electricity produced than more efficient units."*[12]

For these reasons, Santee Cooper agrees with EPA that the MACT floor should be an output-based standard to encourage reduced emissions and improved energy efficiency in new units. Santee Cooper has followed the exact same approach that EPA used in the 2004 Utility MACT proposal, which is to calculate the MACT floor as an input-based emissions standard and then use the EPA-suggested heat rate to convert the standard to an output basis. This approach can be consistently applied to all new sources and is an appropriate way to establish a floor to promote new sources to develop greater emissions reductions as well as better energy efficiency to prevent pollution.

Furthermore, there are at least four technical reasons that bolster EPA's justification for using a generic heat-rate, instead of a plant-specific design heat rate, for converting heat input based standards to energy output based standards. These technical reasons relate to the fact that the use of the Pee Dee design heat rate will not reflect a performance level that can be achieved in practice over the life of the Pee Dee units under the full range of operating conditions. Specifically, technical reasons not to use the Pee Dee design heat rate to establish an enforceable emission limit include the following:

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[11] 69 Fed. Reg. at 4,667, 2nd column.

[12] Ibid.

1. ***Heat rates vary with unit load.*** A unit's heat rate is higher (efficiency is lower) at partial load than at full load. The design heat rate is a "fresh new, full load" specification, meaning that it represents the expected unit performance when the power plant is new, and operating at full load. The mercury emission limit is an annual average, reflecting the actual performance of the unit over time, which ensures that it will reflect a mixture of full load operation and partial load operation.

2. ***Heat rates vary over time.*** As a unit ages, performance will deteriorate, even with attentive maintenance and the economic incentive of lower fuel costs for lower heat rates. Moreover, as the heat rate of a unit increases, its variable cost of operation will increase,and the unit will generally be dispatched at a lower level, relative to other units in the system. This creates a compounding effect on heat rate, because at lower dispatching the unit operates more at partial load, further impacting average heat rate.

3. ***Heat rates are higher at startup.*** During the unit's initial startup, there is generally a period of suboptimal performance when heat rate is higher than the design specification.

4. ***Heat rates vary with system configuration.*** The Pee Dee unit is subject to the same dispatching issues as any other unit in the Santee Cooper system. In future years, as additional units are introduced into the system, the dispatching order of the Pee Dee unit will likely decline, and with that decline there will be a degradation in heat rate based on greater partial load operation.

In summary, if the conversion to an energy output-based emission limit is performed using a unit-specific heat rate, EPA's intent to encourage energy efficiency is completely negated, and the result would be a perverse incentive to design and build units with lower generating efficiencies. Additionally, the design heat rate for the Pee Dee unit does not represent the average heat rate likely to be experienced over a year, or in typical operation over the life of the unit. Therefore, Santee Cooper requests that, when establishing the MACT floor, DHEC utilize the heat rate recommended by EPA in its mercury notice of proposed rulemaking as suggested and provided in the calculations establishing the floor for mercury in the Case-by-Case MACT application.

6. ELECTRICITY COST IMPACTS

Santee Cooper is unaware of any case-by-case mercury analysis, whether for Prevention of Significant Deterioration (BACT) or for MACT, that determined removal costs on a kW-hr basis rather than a cost-effectiveness basis. Using a kW-hr cost basis for emissions reductions would potentially have the effect of making control expenditures appear very small, when in fact, if properly expressed on a $/ton removed basis, would be exorbitant. The reason that cost effectiveness is the appropriate benchmark is that it is important to determine what benefit might ensue from the expenditure.

7. Post Control Emissions

Santee Cooper has previously provided the calculations for post control emissions of SO_2 in Section II.A. of the *Santee Cooper Response to Public Comments On The Draft PSD Permit For Pee Dee Generation Station*, submitted on July 15, 2008. Please reference this section for the requested post control calculations and respective control efficiency.

In regards to CO, the utility industry does not have a pollutant-specific control device. Oxidation catalysts are the primary control devices used to reduce CO emissions. There are no oxidation

catalysts available for electric utility boilers. Santee Cooper has previously provided information on this topic in Section II.G. of the *Santee Cooper Response to Public Comments On The Draft PSD Permit For Pee Dee Generation Station*, submitted on July 15, 2008. Please reference this section for additional information on oxidation catalysts.

As such, Santee Cooper's application includes the appropriate BACT for CO through the operation of the boiler using good combustion practices. Optimizing unit efficiency provides environmental and economic benefit. Furthermore, CO is a product of incomplete combustion, and is expected to vary with changing boiler conditions and loads. Having an indirect relationship with NO_X formation makes it difficult to identify a specific CO emission rate that is aligned with the same operation that results in the maximum NO_X reduction. Santee Cooper is currently collecting CO data at the Cross Generating Station to identify actual average CO emissions that are likely, and will provide this data to DHEC.

Finally, by switching to a baghouse for particulate control, Santee Cooper expects to achieve the same low post control PM (filterable) emissions of 0.015 lb/MMBtu as provided in the previous Pee Dee application. In general, baghouses are better at removing fine particulate matter due to the development of filter cake on the bags. The size of metal HAPs from coal combustion are typically in the particulate fines. As such, the baghouse is expected to help with control of metal HAPs through improved fines collection.

The design values for the coal to be combusted at the Pee Dee facility are noted in section 2.1 of Volume I of Santee Cooper's *Prevention of Significant Deterioration Permit Application*. Based on a maximum boiler heat input of 5,700 MMBTU/hr and a worst case coal heating value of 11,000 BTU/lb, one of the proposed Pee Dee boilers would need to combust 259.1 tons of coal per hour to maintain this heat input. Given a worst case ash content of 17% in the coal, the pre-control particulate loading would be 44 tons per hour. Based on a worst case removal efficiency of 99.9% of particulate, emissions would be 0.015 lb/MMBTU.

If you have any additional questions, please contact Julie Jordan Metts, P.E. at (843) 761-8000, extension 4688.

Sincerely,

Jay Hudson, P.E.
Manager
Environmental Management

cc: Elizabeth Basil

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JAH:JJM:KJC:dss